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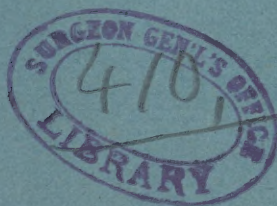
THE PRESENT POSITION OF  
ANTISEPTIC SURGERY.

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# THE PRESENT POSITION OF ANTISEPTIC SURGERY.<sup>1</sup>

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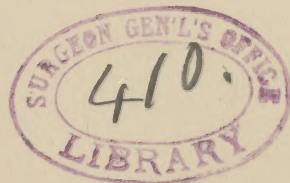
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FOR several years it has been my custom in my lectures at the University of Pennsylvania, to pass rapidly over the evidence in support of the antiseptic theory of wound treatment, with the remark that the time for argument had passed and that it was merely necessary now to present such facts as might serve to make clear the principles involved and to emphasize the enormous benefit that has resulted from the application of those principles to practical surgery. It seemed to me that the theory of antiseptis rested upon a mass of correlated facts, experimental, clinical and bacteriological, sufficient to establish it on a firm foundation, and that the only debatable ground remaining was that relating to the selection of methods and the improvement of details. I considered that the problem had been so scientifically stated and that its solution had been so thoroughly accomplished that, as regarded the general principles, no opposing views worthy of mention remained for discussion or refutation.

I also thought that the whole history of the development and establishment of this great theory, while including the admirable labors of hundreds of medical men in all parts of the world and constituting one of the brightest chapters in the record of human progress, yet centered around the figure of the English-speaking surgeon, whose name was identified with it from its

<sup>1</sup>A reply to Mr. Tait's recent criticism of Sir Joseph Lister's Berlin Address.

Read in the post-graduate course of the University of Toronto, December 19, 1890.



incipiency, in whose mind the grand conception first took practical and definite shape, and whose patient, unassuming, conscientious work in elevating his original thought into a working hypothesis and in transforming the latter into a theory of world-wide acceptance, seemed to me to present perhaps the best, and certainly the most important, example of the application of purely scientific methods to practical surgery to be found in the history of the profession.

These, I say, have been my views, stated more and more dogmatically to successive classes as time went on, and with less and less thought of possible error or of contradiction from respectable surgical authorities. Of course there are always persons in every profession and in every community whose brain cells react to new thoughts and ideas as their grosser tissues to foreign bodies. A condition of irritation is set up followed by the expulsion of the intruder or by its encapsulation and virtual disappearance. Vaccination for variola has to-day its dozens of bitter opponents; for other infective diseases, its hundreds of skeptics; the theory of evolution which has revolutionized the natural science of this century is still violently attacked; and although the laws of gravitation and of planetary motion are now quite generally admitted, we have in Virginia a colored clergyman who still proclaims his belief in the sun's motion. As regards the antiseptic theory we can usually afford to turn a deaf ear to this class of opponents, many of whom have about as much claim to speak with authority on surgical or scientific topics as the Reverend Mr. Jasper on astronomical subjects.

When, however, a noted surgeon, a successful operator and a vigorous controversialist undertakes to traverse the whole line of thought and argument upon which my confident acceptance of the theory was founded, denies its basal facts, ridicules its logic, jeers at its methods, challenges its records and abusively attacks its author and his supporters; and when I find such views, so expressed, published and republished in the most reputable medical journals of the day, with little or no editorial censure, it seems to me proper that those of us who are teachers should once more review the evidence, consider the situation and, according to our conclusions, publicly



re-affirm or renounce our faith in the theory and practice of antiseptis.

On the 4th of last August I had the pleasure of hearing Sir Joseph Lister deliver before the International Medical Congress at Berlin, an address upon "The Present Position of Antiseptic Surgery." He evidently did not think it necessary in the presence of that vast audience, containing many of the most distinguished men in Europe and America, to defend or even to re-state his position as to antiseptis, but devoted his time to noting the new light which had been thrown on the behavior of wounds by the results on the one hand of Koch's discovery of the method of cultivating microbes upon solid media, and on the other of Metchnikoff's researches into the phagocytic action of the migratory or amœboid cells of the human body. According to Lister, Koch's work has rendered it possible to study with greater precision than ever before the habits and behavior of micro-organisms and he instanced the discovery of the cholera microbe as a notable example of the results of this method. Detailing some of Metchnikoff's experiments to prove the antibacteric action of normal leucocytes, he called attention to the explanation it offered of much that was hitherto mysterious in the relation of micro-organisms to wounds, the healing, for instance, of wounds like that made in the operation for hare-lip, the posterior edge of which is perpetually bathed in saliva containing septic bacteria. The destruction of these microbes by the leucocytes which people the lymph at the edge of the wound satisfactorily explains the rapid healing which we uniformly obtain after this operation. So, too, he thought that in cases where fine silk ligatures are used unpurified and left in closed wounds the phagocytic action of the normal tissues may destroy the microbes that have gained access to the interstices of the thread and prevent their fermentation or putrefactive action on the discharges.

He then considered the question of drainage and of irrigation, pointing out the possibility of dispensing with both in many wounds, and suggesting that in the new light thrown upon the ability of normal tissues to protect themselves, contamination from atmospheric organisms may perhaps also be disregarded, provided no septic matter be otherwise introduced

into wounds. In support of this he noted the fact that it had been found that the free entrance of air containing microbes into the pleural cavity in cases of empyema had produced no harmful results in the days when the spray was irrationally depended upon to sterilize such air, and instanced the transformation of the purulent contents of the pleural cavity into a rapidly diminishing serous effusion, the closure of the external opening, the resumption of the normal functions of the pleura, the expansion of the contracted lung through atmospheric pressure,<sup>2</sup> etc., as a beautiful example of the reparative processes of nature when uninterfered with by mischievous agents from extrinsic sources. The contrasting course of those cases in which in pre-antiseptic days the discharges escaping from the wound became infected and underwent putrefactive fermentation, is familiar to most of you.

He then emphasized the need for antiseptic rather than aseptic dressings in cases where large discharge is unavoidable and concluded with a reference to the double-cyanide dressing which he has been using for eighteen months.

This address seemed to me as I listened to it to be another

<sup>2</sup>This statement Mr. Tait criticises (if it can be called criticism) most violently, calling on the "shades of Newton and Toricelli" in mock dismay at the disregard of physical laws which he thinks it manifests. He misquotes Lister who spoke of the closure of "the external opening." This Tait transforms into "closure of the affected cavity" and then says that "given a membrane to which the atmosphere has free access on both sides, on both of these sides the pressure of the atmosphere will be exactly the same"—a self-evident proposition but one which has nothing to do with the condition of the lung and pleura after the chest wall has become impervious. He says, also, that when the closure of the pleural cavity is completed "the natural dimensions of the affected lung are *always* remarkably diminished." In contradiction of his whole position in this matter I would refer to the following authorities: West, on Pneumothorax (*The Lancet*, 1887, vol. 2, p. 353); Williams on the use of a Valvular Tube in Empyema (*British Medical Journal*, May 18 1889); Reynolds, on Pneumothorax Consecutive to Emphysema (*Manchester Medical Chronicle*, October, 1889); Douglass Powell, on Variations in Intra-thoracic Pressure (*Transactions of International Medical Congress*, 1881, vol. 2); Donaldson, on Diseases of the Pleura, (*American System of Medicine*, vol. 3 pp. 522, 559). The latter author says: "The dilatation of the lung is produced by the disappearance of the intra-pleural pressure and the pressure in the opposite direction, from the bronchial surface." The whole question is, of course, a distinct digression but is used by Tait in justification of his assertion that Lister "possesses crude notions of logical definition."



striking example of Lister's remarkable willingness to receive and profit by all new discoveries and all genuine advances bearing upon the antiseptic theory. So far as I know he has never remained silent in the face of satisfactory demonstration that any portion of his method was unnecessary or illogical. As he gave up the spray when it became evident that it was not accomplishing its work, as he has from time to time discarded various antiseptics in the search for the ideal one combining permanency and certainty of action with absence of irritating qualities, so he now is willing to minimize the dangers of atmospheric contamination and to discard washing, irrigation, and even drainage in appropriate cases although for years he has been conscientiously emphasizing their importance. Surely this is the true scientific spirit, as rare as it is admirable, and an additional evidence of the single-mindedness and absolute fairness of this great investigator.

On the 27th of last September there appeared in *The British Medical Journal* an article by Mr. Lawson Tait, consisting of an address delivered a short time previously and entitled "The Present Aspect of Antiseptic Surgery; A Criticism of Sir Joseph Lister's Address at the International Congress."

Of the tone, taste and temper of this essay I shall have but little to say. It would be difficult to characterize it properly and preserve the dignity and decorum which should belong to scientific discussion, but which are so conspicuously absent in Mr. Tait's paper. So far, however, as concerns our present purpose it may be considered from two standpoints: 1. As it denies the truth of the principles underlying the practice of antiseptis, and advances an alternative theory applicable to the treatment of wounds. 2. As it attacks the prevailing antiseptic methods.

I. THE PRINCIPLES INVOLVED. Mr. Tait draws an elaborate comparison between the phlogiston theory of Stahl and the antiseptic theory, asserting, to use his own words, that we have a perfect parallel to the former in "the septic theory of inflammation and fever which is the favorite hobby-horse of our own day." He adds "everything at present has a septic origin and a septic inception, yet I venture to say that before the present generation has run out the word antiseptic will be

all that is left to represent the strange structure, just as anti-phlogistic was the only word left to represent the phlogistic theory in the middle of the present century." He continues by asserting a want of logic in the use of the term "theory" at all, saying that "instead of the septic or antiseptic fact, Lister and his still more illogical disciples talk of the septic or antiseptic theory, whereas there is no theory about it at all, but an absolute and ludicrous logical error." He then opens his argument by denying that the cholera bacillus has been definitely isolated or that it can be cultivated with certainty and precision; and says that even if it has and if it is potent for production or reproduction, the fact that if a thousand people drink the same germ-infected water only a hundred or so will be affected, and that the majority of these will recover, shows that the facts about germs in the human body do not coincide with the facts of the germs in the gelatine flasks and that, therefore, they cannot stand as the basis of a working hypothesis, far less of a theory.

It is difficult to follow the vagaries of this extraordinary paper, but if all this means anything whatever it means that, taking the cholera bacillus as a type, all deductions based upon bacteriological investigation are denied because the growth and reproduction of micro-organisms in the body are so influenced and altered by physiological and vital processes as to run a course somewhat different from that which they take in flasks or test-tubes. For the same general reason and because it will not immediately explain the differences among the clinical courses of various infective diseases Mr. Tait rejects the phagocyte theory, apparently assuming that if it is true there should be a uniform destruction of bacilli of all varieties. One might as well deny the essential element of conception, the fusion of the ovum and sperm cell—possibly an instance of phagocytosis—because of the variations in the resulting animal. This position is, however, in harmony with his denial of the value of vivisection for similar reasons, and illustrates the working of a mind which he is pleased to consider "logical." The assumption that this is what he is clumsily attempting to say is also justified by several other paragraphs which will serve at once to display his real ignorance of the teachings of Lister and to



illustrate the character of his address. He says "If the entrance of germs into a wound was the immediate and real cause of suppuration and of consequent poisoning the device of the spray was the most completely logical appliance that could have occurred to the mind of man." "Even if the phagocytes are the means by which the tissues resist the omnipotent and ever-present germs it is the phagocytes and their conditions which must constitute the really important elements of the question; keep your phagocytes up to the mark and you need never bother about germs." "With the Listerian one germ is as good as a thousand." "If it would gratify the phagocytes in any way I would stuff the abdomen like pudding with the germs or bacilli of decomposition provided there was nothing present for them to feed upon." He finally sums up his position in the two following paragraphs—Lister's view was "Keep out the germs and you may leave blood-clot (and other matters) to take care of themselves." My view was and is, "Get out all decomposable matter and you can let the germs in freely." "There are two factors in the trouble and it can be shown conclusively that one, the germs, are wholly inconsiderable without pabulum on which to feed; whilst the other, the pabulum is sure to breed trouble because it is practically and mechanically impossible to keep the germs out; they exist already in the blood and elsewhere, and are ever present according to the best authorities."

This amount of quotation I was reluctantly compelled to make to elucidate his views but we may now ask "what are the *facts* in the case?"

The evidence necessary to prove the definite etiological relation of a particular micro-organism to a specific disease in man is as follows: The organism must be unmistakeably recognizable at different periods of its growth; it must be isolable; it must be capable of cultivation alone and free from association with other organisms; it must be invariably associated with the disease in question; it must be capable by inoculation of producing that disease; it must retain this power through an indefinite series of cultures. If these conditions were fulfilled in but a single instance it would be sufficient to demonstrate the folly of the general attack on all germ theories contained in

Tait's paper,—but at least five well-known examples may be mentioned of indisputable relation of cause and effect between specific pathogenic microbes and infective disease. Since 1879 when Koch first demonstrated the connection between definite micro-organisms and various wound diseases the evidence has steadily accumulated. Ogston in 1881, Rosenbach and Cheyne in 1884, Passet in 1885, Zuckermann in 1887, have shown that the various staphylococci have as distinct a causative relation to acute suppuration as has the yeast plant to the alcoholic fermentation. They can be found in and cultivated from the pus in every recent abscess; they invariably produce suppuration when pure cultures are injected, even to the twentieth generation. Their effect may or may not be aided by the ptomaines which they produce, but as the amount of ptomaines is directly proportionate to the number of microbes present and as the ptomaines are never produced at all in the absence of the microbes the question as to the relative importance of the two has, as Senn long ago said, but little interest for the practical surgeon, and can have none at all for the "purely unscientific person" that Mr. Tait with truthfulness represents himself to be.

Another example is to be found in malignant pustule, the specific cause of which, the bacillus anthracis, is readily cultivated in different media and produces the disease when inoculated in the smallest possible quantity.

Fehleisen in 1883 showed that erysipelas depended upon a streptococcus, inoculation of which when quite pure produced the disease in six out of seven cases, the exception occurring in a person who had recently had an attack of erysipelas and was scarcely more than convalescent.

Acute osteo-myelitis has until recently been thought to be due to the ordinary microbes of suppuration, but the researches of Becker and Krause (1883) and others have made it probable that a specific micrococcus is the essential element of the disease.

Tubercle furnishes the last of our examples of microbic disease and we have just learned that to Koch, who in 1882 discovered the tubercle bacillus, we possibly owe the equally brilliant and infinitely more important discovery of its antidote.



In the face of this collection of facts, of such transcendent importance to surgery and to the world at large, we can afford to pass by without further mention the bacilli of tetanus, typhoid fever, and glanders, the micrococci of lobar pneumonia and of gonorrhœa, and the microbes of cholera and of gangrene, although it is quite clear to all persons capable of weighing scientific evidence that it is a question of time only, when our knowledge of these microbes shall be as definite as of those I have enumerated.

In the face of this evidence we may assume that Tait's general and contemptuous rejection of *all* surgical theories dependent upon our knowledge of germs is not warranted by the facts in so far as suppuration, erysipelas, tubercle, anthrax, and osteo-myelitis are concerned, and therefore that there is no *a priori* ground for rejecting *every* theory involving a belief in the potency for mischief of micro-organisms.

It is more directly to the point, however, to inquire into the evidence in favor of the germ theory of septic wound disease, and here we must briefly consider some very elementary questions. Mr. Tait takes great pains in one portion of his paper to emphasize the fact that "such bacilli as cause decomposition and such as have specific properties split out from dead organic matter some horrid things," i.e. in other words that they act as ferments causing that form of fermentation which we know as putrefaction. Mr. Tait is as usual inaccurate in his statement—as the *micrococcus erysipelatosus*, for example, which is undoubtedly a microbe with specific properties, does not cause any putrid change; but he would have been correct in asserting that all organisms produce changes in the materials in which they grow, which means that they all cause *some* kind of fermentation.

The antiseptic treatment of wounds might under Mr. Tait's ruling be described as a treatment directed against the causes of putrefaction in wounds, but a more accurate definition expands it, as Mr. Cheyne has suggested, so as to include treatment directed against the cause not merely of the putrefactive fermentation but of all fermentations. Accepting this very liberal definition our scientific evidence leads us to the adoption of the antiseptic theory by the following steps, each of

which is as demonstrable as the single rule of three or the *pons asinorum*.

Fermentation (whether putrefactive or otherwise) in organic substances, such as blood clot or serum or pus, or the discharges from wounds, depends upon the access to these substances of micro-organisms. The proofs of this fact are two-fold. Experimentally it is shown by the certainty with which easily decomposable substances like blood, urine, or beef tea may be kept indefinitely sweet by simply protecting them from germ contamination. Clinically it forms the basis of all subcutaneous surgery; explains the difference between simple and compound fractures and, taken in conjunction with another fact,—viz., that the fluids and tissues of the healthy living body are practically sterile, it also explains the difference between the behavior of a case of arterial occlusion affecting a portion of the surface of the body and producing gangrene or sloughing, and a case of similar occlusion affecting an internal organ and producing atrophy and retrograde metamorphosis.

The last fact I mentioned—the sterility of the blood and tissues—is denied by Mr. Tait, who says “the germs exist already in the blood and elsewhere, and are ever present, according to the best authorities.” The elaborate and carefully conducted experiments of Hauser,<sup>3</sup> Watson Cheyne<sup>4</sup> and others completely contradict this statement, which is really the foundation of Mr. Tait's argument. As we have seen, the evidence that germs cause fermentation is undeniable and it is equally true that germs can be excluded from wounds by antiseptic precautions or can with less certainty be destroyed after they have gained access. This statement rests on the one hand upon microscopical evidence (microbes being demonstrably absent from the discharges of properly sterilized wounds and as constantly present in suppurating or sloughing wounds); and on the other hand upon a mass of clinical testimony familiar to every member of the profession. A portion of this testimony, in spite of its triteness, it is necessary to recapitulate in order to complete the argument: The germ theory of fermentation

<sup>3</sup>Archiv. f. Experiment, Pathologie and Pharmacol., bd. 20 p. 162.

<sup>4</sup>British Med. Jour., March 3, 1888.



is undisputed; fermentation in wounds can therefore be prevented by the exclusion of germs; it has been shown microscopically that these can be kept out (asepsis) or can be destroyed (antisepsis); practically therefore it only remains to show the effect upon patients with operative or other wounds of excluding or destroying germs to show the value or lack of value of antisepsis and the antiseptic theory. By looking back a few years to the very beginning of the employment of antiseptics we can obtain the most striking and convincing evidence of the effect of treatment directed almost exclusively, though then very imperfectly, against the introduction of bacteria.

The record of the work of Prof. Lister may well begin our series of examples: In Glasgow, in 1864, 1865, and 1866, Mr. Lister's mortality in a series of operations of all sorts was 45.7%, largely from septic diseases. About this time he began to employ, gradually, some antiseptic methods in his treatment of wounds and during operations. In 1867, 1868 and 1869, his mortality fell to 15%. At Edinburgh, having greatly improved the details of his system, we find that from 1871 to 1877 he treated 553 grave surgical cases with a mortality from septic disease of only .36%, a diminution in the death-rate which, when we remember that these different results were obtained by the same man operating upon the same class of patients and for the same injuries or diseases, is so striking as to be in itself conclusive. Still later, an opportunity was afforded to compare Mr. Lister's results with those of a colleague, Mr. Spence, working in the same hospital, but declining to employ antiseptic methods. The total results of their major operations showed that Mr. Spence lost just about three patients where Mr. Lister lost one, while the deaths from infective diseases were 2.4% among Spence's cases and one-third of 1% or 8 times less among those of Mr. Lister. When we turn to the work of other surgeons we find evidence, if possible, still more conclusive of the value of these methods. Nussbaum has shown that during forty years in his clinic under his own direction as well as that of his predecessors, among whom was Stromeyer, the deaths from wound diseases were so common that patients with even the slightest injuries often succumbed to them; that erysipelas and abscesses were matters of

daily occurrence; that 80% of all wounds and sores were attacked with hospital gangrene, and that nearly all patients with compound fractures died; and he states that immediately upon the introduction of the antiseptic system, all these diseases vanished; and healing by first intention, previously almost unheard of in his service, became the rule instead of the exception. Prof. Volkmann, in an address before the International Medical Congress which met in London in 1881, testified strongly and clearly to the results obtained in his own practice, selecting two subjects especially, compound fractures and major amputations, as evidence of the value in his hands of the antiseptic method. He said that the mortality after compound fracture had, during the long labors of the surgeons who preceded him as well as during his own, reached the sad height of 40%. Immediately before he adopted the antiseptic method of treating wounds, his last twelve patients with compound fracture had all died of pyæmia or septicæmia. From that time up to the period at which he delivered this address he had treated 135 compound fractures without losing a single patient from either of these wound diseases; 133 were cured; 2 died, one of fatty embolism of the lungs during the first few hours, and one, a drunkard, of delirium tremens. As to the amputations, he asserted that he now cured each year with the antiseptic method more cases of amputation of the thigh, for example, than during all the rest of his labors before the introduction of the method. In an article on the treatment of compound fractures, Prof. Dennis, of New York, has compiled further evidence in this same direction. In the Pennsylvania Hospital, between the years 1839 and 1851, there were treated 116 cases of compound fracture of the leg and thigh; excluding those cases requiring amputation there were 51 deaths, a mortality of 45%. In the New York Hospital, during the same period, there were treated 126 cases of compound fracture of the leg and thigh; excluding amputations there were 61 deaths, a mortality of 48%. From 1860 to 1876 there were reported from the surgical clinics of Vienna and Zurich by Billroth, 180 cases of compound fractures; excluding amputations there was a mortality of 41% from septic disease. In the Obuchow Hospital Reports of St. Petersburg 106



cases of compound fracture gave a mortality of 68 %. In Guy's Hospital, from 1841 to 1861, there were reported 208 cases of compound fracture with 50 deaths, a mortality of 26 %. After the introduction of antiseptis this death-rate immediately fell to 4 % from an average of 40 to 50 %, and in this article of Dr. Dennis, in which he reports 516 cases of compound fractures, there was no record of death from septic trouble in any fracture of the extremities, which was the class of injuries included in the above statements. I might easily multiply such evidence as this a thousand-fold, but it seems unnecessary to repeat what has long been so familiar. And yet it is upon this evidence, which I have endeavored to condense, that the antiseptic theory rests. The facts and figures could easily be replaced by newer statistical matter but I have selected these for the very reason that they show better than more recent experiences the wonderful changes wrought solely by the employment of antiseptics under circumstances otherwise unaltered—drainage having been previously used, the amount of "pabulum" in the wounds remaining the same, the operators and surroundings being just as in the days of gangrene and pyæmia. Mr. Tait endeavors to break the chain of reasoning by saying, 1., that the germs are everywhere and cannot be got rid of—a misstatement—and 2., that the presence or absence of sepsis depends on the presence or absence of "pabulum" *i. e.*, dead organic matter, blood clot, serum, etc. It has been one of the axioms of antiseptic surgery from the beginning that scrupulous attention should be paid to hæmostasis and to drainage. No one has taught this more earnestly than Lister and his followers, and Tait's adoption of it as *his* "view" is evidence of his ignorance of the work of others. To be sure he says that Kœberle first taught him drainage in 1875, and gives due and deserved credit to Chassaignac for his work in this direction, but English and American surgeons have employed drainage fully and carefully since the early part of this century and Syme (afterwards Lister's father-in-law) in 1826, made the importance of providing a free escape for the discharges from wounds the subject of one of his most important papers. It is easy to say that if you have nothing to decompose there will be no decomposition, for that is what it amounts to.

"Get out all decomposable matter" he says, "and you can let the germs in freely," but in practical surgery this is by no means always possible. It is really to be regretted that Mr. Tait has not had an opportunity to see some general surgery, and particularly to follow Lister's practice at King's College Hospital. I am curious to know how he would interpret a case which I saw there in 1888 and described as follows, in a letter to *The Medical News*: It was a case of operation upon a fractured patella with elongation of the quadriceps by Cameron's method, in which there had been muscular spasm followed by extensive oozing from the cut surfaces. "A large clot formed, producing considerable tension, necessitating the removal of the stitches, and causing at two points a slight separation of the edges of the wound. I watched this for ten days, and instead of the flush, the suppuration, the elevation of temperature and the alarming symptoms which would usually follow such hæmorrhage into and about a great joint, the patient and the limb both remained perfectly passive, with absolutely no sign of either local or constitutional irritation, while the clot itself gradually contracted and the knee resumed its normal outline. During all this time there was literally not one drop of pus and not a trace of offensive odor. A severer test of Prof. Lister's antiseptic methods could hardly be devised or imagined."

There was no lack of "pabulum" here, but it gave rise to no evil effects, while on the other hand I am sure that there is not a practical surgeon in the world to-day, no matter how "humble" or "unscientific," who doesn't know what the result would have been if the germs had been "let in freely." The numerous successful cases of Schede's method of utilizing blood-clot in the filling of bone cavities are similar arguments and of a most convincing kind.

Ignorance of general surgery and highly specialized experience offer the only explanation of such astounding statements.

Mr. Tait deals habitually with a membrane, the peritoneum, which has a remarkable power of self-protection. Microbes gaining access to the abdominal cavity are exposed to de-



struction either by the serum which it copiously exudes, or by a possible phagocytic action of its enormous numbers of endothelial cells, or by both. I have thought, too, that possibly the extraordinary cases of cure of peritoneal tuberculosis after simple laparotomy and flushing of the abdominal cavity were due to the stimulation of the membrane (through removal of pressure or through contact with the irrigating fluid) to greater exudation and of its cells to greater anti-bacteric activity. It is merely a supposition, but seems as reasonable as any of the explanations I have heard offered. At any rate these properties are well known, and if one could anywhere in the body depend on the restriction of the amount of "pabulum" rather than on the exclusion of the germs it would be here.

Mr. Tait, after contemptuously discarding *all* surgical theories, including that of antiseptis ventures upon one of his own. He thinks the phenomena of sepsis due to the "dose" of dead tissue or "pabulum," and of the poison resulting from its decomposition and with a momentary forgetfulness of his "humility" he actually advances this as an original "working hypothesis." It would sound very much to the general surgeon as if Mr. Tait had never heard of sapræmia, which is described by a "Listerian"<sup>5</sup> as follows: "Sapræmia or putrid intoxication represents that form of septicæmia in which a preformed toxic agent is injected into the circulation and in which the maximum symptoms are reached as soon as the poison has become mixed with the blood. This form of sepsis may be caused by any microbe, otherwise harmless, or with only slight pathogenic properties, as the bacillus of putrefaction, which causes putrefaction in any dead tissue as, for instance, a blood clot or contused tissue; and the symptoms arise as the ptomaines are absorbed, and are appropriate to the amount absorbed, and subside with the cessation of absorption and their elimination through some of the excretory organs."

Mr. Tait's remarks against dosage are further evidences of his ignorance of Listerian work and teachings. He says: "With the Listerians one germ is as good as a thousand." I suppose it is safe to class Mr. Watson Cheyne, whom I have

<sup>5</sup>W. Cheyne.

just quoted, as a "Listerian." Indeed, he has for years been Lister's assistant and authorized mouth piece. In Mr. Cheyne's lectures on "Suppuration and Septic Diseases"<sup>6</sup> he not only asserted but proved experimentally that the number of bacteria introduced modified greatly the intensity of the symptoms and even the character of the disease. He experimented with cultivations of Hauser's *proteus vulgaris*, finding that one-tenth of a cubic centimetre caused immediate death; one-fortieth of a cubic centimetre caused death in six to eight weeks; smaller doses produced no effect. Similar observations have been made by Passet,<sup>7</sup> Pawlousky<sup>8</sup> and others and are as well known as any in connection with antiseptic surgery.

It is evident that what is original in Mr. Tait's "hypothesis" is not true and that what *is* true in it is not original.

2. THE PREVAILING ANTISEPTIC METHODS.—It seems apparent at any rate that, to put it mildly, Mr. Tait is not a safe or reliable authority on the general subject of surgical antiseptics, but towards the end of his paper he ventures on a specific fling at Lister's last surgical dressing. After asserting that "Listerism" is "as dead as Julius Cæsar," he adds: "The mischief probably is not at an end, for we hear that the last phase of this astonishing craze is that wounds are to be dressed with still a new contrivance, one as deadly and dangerous as anything that can well be imagined—a double cyanide." I am especially interested in replying to this statement for the reason that, owing to the kindness of Sir Joseph Lister (who during the summer of 1889 gave me confidentially the various formulæ which he was using and supplied me with the materials from his own manufacturers of gauze and chemicals), I was the first surgeon in this country to employ the dressing in question and because I now have a series of cases in which it has been used, large enough to justify publication. The history of the steps which led up to the employment of this

<sup>6</sup>Brit. Med. Jour., March, 1888.

<sup>7</sup>Monatshfte f. Prakt. Dermatol., B. 6, No. 10. 1887.

<sup>8</sup>Centralblatt f. Chirurgie, No. 48, 1887.

material must be briefly mentioned both to explain its selection and in reply to the charge of "perpetual shifting."

The aim of the surgeon after every operative wound is, of course, to secure union by first intention. Any persistent irritation is a source of trouble in wounds, and the different antiseptics which have been employed have not been free from the charge of contributing to the occurrence of excessive inflammation by their own irritant action. The typical antiseptic must, therefore, be as nearly as possible devoid of irritating properties. It must be germicidal—that is, it must possess the power of destroying the micro-organisms. It must have an inhibitory power—that is, it must prevent the development of such organisms. It must be stable—that is, it must not disappear from the dressings after they are made, or after they are applied to the wound either by solution in the discharges or by volatilization.

In the old Listerian method carbolic acid was the antiseptic employed; but this had the disadvantage of volatility as well as great slowness of action as a germicide. Corrosive sublimate, which succeeded it, was stable and acted rapidly, but was exceedingly irritating, and, in addition, was precipitated by the albumen contained in the serum of the blood. This precipitate, it was discovered by Sir Joseph Lister, possessed powerful antiseptic properties, with much less power of producing irritation; and he, therefore, devised a form of antiseptic dressing called "the sero-sublimate gauze," which consisted of gauze charged with a solution of corrosive sublimate in the serum of the blood. This, however, was difficult to manufacture, and produced a harsh and non-absorbent material which was mechanically objectionable. It was succeeded, in his hands, by a combination of chloride of ammonium and bichloride of mercury, known as sal-alembroth, which, while much less irritating, was so exceedingly soluble in the blood serum that whenever the discharges from the wounds were copious it was washed out of the dressing, leaving them without antiseptic property. For these reasons Lister in time discarded this material and employed for a considerable period a gauze containing 3 or 4%, by weight, of the biniodide of mercury. This was less soluble, non-volatile, powerfully an-



tiseptic, but, again, extremely irritating, so that the least contact with the skin produced an intense erythema, even going on to vesication.

Lister was then led to look further for the ideal antiseptic and finally to employ the double or mixed cyanide of mercury and zinc, which he is now using. Its most evident advantages are, first, that it is non-volatile; next, that it is almost entirely unirritating; thirdly, that it is insoluble in water and only soluble in 3000 parts of blood serum, and, finally, that, while it possesses but little germicidal value, its inhibiting power is so high that a 1-1200 solution is sufficient to keep animal fluids permanently free from putrefaction. This combination of qualities is possessed by no other of the antiseptics which have been mentioned, and its deficiency in germicidal power is easily remedied by including in the manufacture of the gauze dressings which are impregnated with this material a small percentage (1 in 4000) of sublimate, enough to be germicidal, but too weak to be markedly irritating. As I have said, I was told the details of this method *confidentially* in the summer of 1889. The communication was confidential because, while Lister was experimenting with other dressings, notably the sal-alembroth, the announcement had been made by others that he was using them and they were extensively employed at a time when he was quite unprepared for publication upon the subject. Until November, 1889, therefore I employed the double cyanide only in my private work, but since that date, when Lister published his own conclusions on the subject, have used it after nearly all my operations at the University Hospital. I present here with in tabulated form the results of the most important of these operations, exclusive of dozens of minor cases which, while as a matter of fact they often test severely the efficacy of any surgical dressing, might be expected to get well under almost any form of treatment.

I have grouped the cases roughly and have avoided unnecessary detail for the sake of economy of space, the main object in publishing them now being to establish the efficiency of the double cyanide dressing and its freedom from dangerous qualities.

TABLE OF SURGICAL CASES TREATED SINCE BEGINNING THE USE OF THE DOUBLE CYANIDE GAUZE.—September, 1889 to December, 1890.

| No. of Cases.<br>—<br>Group. | Operations.                                                       | Memoranda.                                                                                                                                                                                     | Results.                                                                                                                                                                                                                    |
|------------------------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13                           | Removal of cervical glands for tuberculous adenitis.              | Wounds varied in length from two to six inches; in five cases, the dissection was most extensive, being carried along the cesophageal line; in four caseation and suppuration already existed. | Except in the suppurating cases, union by first intention along the whole length of the wound. Drainage tube usually employed, but withdrawn during first two or three days. Fever rarely 100° after second day. No deaths. |
| 2                            | Trephining of cranium.                                            |                                                                                                                                                                                                |                                                                                                                                                                                                                             |
| 3                            | For compound fracture.                                            | Wounds already infected by vuln-erating body and by dirty fingers; careful sterilization by 1:500 sublimate.                                                                                   | Union of scalp wounds by first intention, no pus, no fever, no deaths.                                                                                                                                                      |
| 4                            | For epilepsy.                                                     | In every case operation performed on account of history of traumatism.                                                                                                                         | In three cases union by first intention; one death from suppression of urine and uræmia in an old alcoholic.                                                                                                                |
| 3                            | Abdominal section.                                                |                                                                                                                                                                                                |                                                                                                                                                                                                                             |
| 8                            | For removal of uterine appendages.                                | In every case 1:10000 bichloride solution was used for hands and sponges and when required for irrigation. Tube used in three cases.                                                           | Union by first intention except in two of the tube cases in which stitch abscess occurred; no deaths.                                                                                                                       |
| 4                            | For intestinal obstruction.                                       | In two cases there was general purulent peritonitis and great distention. The obstruction in all four cases was from bands.                                                                    | In two union by first intention and recovery; in the others death within first 24 hours.                                                                                                                                    |
| 4                            | For peri-typhlitic abscess.                                       | In two removal of vermiform appendix; in two evacuation of abscess and use of drainage tube.                                                                                                   | One death in 24 hours, probably from ignorance of nurse, who neglected the drainage tube. In others rapid recovery without fever or other alarming symptoms.                                                                |
| 1                            | For removal of tumors of abdominal wall & cure of ventral hernia. | Operation very tedious and prolonged involving much handling of tissues. Wound brought together by sutures <i>en etages</i> . Patient old and infirm.                                          | Extensive "aseptic suppuration," <i>i. e.</i> , without fever, pain or other symptoms thought to be due to traumatism to the thick layer of subcutaneous fat. Recovery with good, firm cicatrix.                            |
| 4                            | Hypogastric section and cystotomy.                                |                                                                                                                                                                                                |                                                                                                                                                                                                                             |
| 1                            | For exploration.                                                  | No satisfactory explanation found for violent and persistent vesical symptoms, which had lasted for 20 years.                                                                                  | Rapid healing, no suppuration.                                                                                                                                                                                              |
| 4                            | For removal of calculus.                                          | Three stones weighing over two ounces. One small oxalate calculus.                                                                                                                             | All recovered without suppuration.                                                                                                                                                                                          |

TABLE.—CONTINUED.

| <i>Group.</i> | <i>No. of Cases.</i> | <i>Operations.</i>                                                   | <i>Memoranda.</i>                                                                                                             | <i>Results.</i>                                                                                                                                                                                                        |
|---------------|----------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | 4                    | 1 For prostatectomy.                                                 | Very extensive operation, removal of large portions of the prostate.                                                          | Death on eighth day from uræmia and suppression of urine. Kidneys almost completely disorganized.                                                                                                                      |
|               |                      | 1 For exploration and drainage.                                      | An enormous prostate with absolute retention. Patient old and feeble.                                                         | Lived a year in comparative comfort.                                                                                                                                                                                   |
|               | 5                    | 2 Excision of varicose long saphenous vein.                          | Veins extremely long and tortuous. Patient disabled. Incisions 18 and 19½ inches in length.                                   | Rapid union. No suppuration.                                                                                                                                                                                           |
|               | 6                    | 14 Excision of breast with removal of axillary glands.               | In all complete removal of breast, opening of axilla and removal of axillary glands                                           | Not a single suppurative case. Average time of healing and discharge from hospital, 11 days. Average number of full antiseptic dressings, three.                                                                       |
|               | 7                    | 3 Arthrectomy of knee.                                               | In all of them most extensive removal of synovial membrane ligaments, cartilages and osseous foci of disease. All tubercular. | In all rapid primary union of skin wound. In two persistent suppuration in track of drainage tube, but final healing. In one at this date (eight months after operation) re-opening of sinus. In others apparent cure. |
|               | 8                    | 1 Removal of foreign body from knee-joint.                           | A portion of a needle found partly within, partly without synovial cavity.                                                    | Primary union under first dressing.                                                                                                                                                                                    |
|               | 9                    | 3 Removal of superior maxilla.                                       | All three cases of malignant tumors.                                                                                          | Primary union of skin incision; all recovered from the operation.                                                                                                                                                      |
|               | 10                   | 1 Removal of both superior maxillæ with a portion of the malar bone. | For osteoma of both maxillæ.                                                                                                  | Primary union of skin. Entire recovery from the operation.                                                                                                                                                             |
|               | 11                   | 2 Removal of a portion of the inferior maxilla.                      | For osteo-sarcoma.                                                                                                            | Primary union of skin. Prompt recovery.                                                                                                                                                                                |
|               | 12                   | 2 Excision of elbow.                                                 |                                                                                                                               |                                                                                                                                                                                                                        |
|               |                      | For tuberculous arthritis.                                           | Patient had already undergone several operations upon other joints.                                                           | Union by first intention under two dressings except in track of drainage tube. Entire union in three weeks. All movements of elbow preserved.                                                                          |
|               |                      | For bony ankylosis.                                                  | The ankylosis was the result of an old fracture; the arm was extended and useless.                                            | Primary union throughout whole wound under two dressings; functional result excellent.                                                                                                                                 |



TABLE.—CONTINUED.

| No. of Cases.<br>Group. | Operations.                                               | Memoranda.                                                                                                                                                                  | Results.                                                                                                                                                                                                         |
|-------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13                      | Amputations.                                              |                                                                                                                                                                             |                                                                                                                                                                                                                  |
| 8                       | Finger.                                                   | Six from lacerated wounds in crushing accident; two from result of felon.                                                                                                   | All healed by first intention under one dressing.                                                                                                                                                                |
| 1                       | Forearm.                                                  | From tubercular arthritis of wrist and carpus.                                                                                                                              | Primary union under two dressings.                                                                                                                                                                               |
| 1                       | Arm.                                                      | In old ununited fracture at the upper third.                                                                                                                                | Primary union.                                                                                                                                                                                                   |
| 2                       | Foot.                                                     | One malignant tumor of foot, one for crush of foot, both Choparts.                                                                                                          | One healed by first intention, Second recent.                                                                                                                                                                    |
| 3                       | Leg.                                                      | All for railroad injury.                                                                                                                                                    | Primary union in all.                                                                                                                                                                                            |
| 2                       | Thigh.                                                    | One for malignant growth of lower end of femur. One for tubercular osteitis of knee.                                                                                        | In 1 antiseptic suppuration in track of drainage tube which was left in situ or an unnecessarily long time. Final healing. In other primary union under 2 dressings.                                             |
| 14                      | Radical cure of hernia.                                   | All of these cases were strangulated, all were seen and operated on early. In the inguinal cases Barker's method was used; in the femoral a modification of that method.    | All recovered from the operation. In two there were fever and suppuration along the track of the catgut drainage. In one there is already a return of the hernia. In the others the cure <i>seems</i> permanent. |
| 3                       | Inguinal.                                                 |                                                                                                                                                                             |                                                                                                                                                                                                                  |
| 2                       | Femoral.                                                  |                                                                                                                                                                             |                                                                                                                                                                                                                  |
| 15                      | 2 Parotid tumor.                                          | Both cases were examples of tumors over the parotid originating in the lymphatic rather than true tumors of the parotid itself.                                             | Primary union in one. In the other a little aseptic oozing for a week.                                                                                                                                           |
| 16                      | 1 Osteotomy and re-fracture of bones of the forearm.      | For angular deformity following badly treated fracture. Open wound.                                                                                                         | Primary union under two dressings. Cure.                                                                                                                                                                         |
| 17                      | 1 Myotomy of adductor, sartorius & tensor vaginæ femoris. | For contractures of long standing.                                                                                                                                          | Primary union.                                                                                                                                                                                                   |
| 18                      | Removal of tumors.                                        |                                                                                                                                                                             |                                                                                                                                                                                                                  |
| 11                      | From scalp.                                               | In eight cases the operation was for the removal of sebaceous growths. In three, included here for convenience, a painful scar was excised for supposed traumatic epilepsy. | In every case there was primary union except (in three along the track of the drainage tubes. In no case was there fever or suppuration.                                                                         |
| 3                       | From neck (exclusive of tuberculous glands).              | Hydrocele of the neck; two malignant growths of neck.                                                                                                                       |                                                                                                                                                                                                                  |

TABLE.—CONTINUED

| <i>Group.</i> | <i>No. of Cases.</i> | <i>Operations.</i>                 | <i>Memoranda.</i>                                                                                                                                                                                                | <i>Results.</i>                                                                                                                                      |
|---------------|----------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                      |                                    |                                                                                                                                                                                                                  |                                                                                                                                                      |
| 18            | 4                    | From back.                         | Three fatty tumors; one large cyst.                                                                                                                                                                              | There were no deaths.                                                                                                                                |
|               | 1                    | From thigh.                        | One large fatty tumor,                                                                                                                                                                                           |                                                                                                                                                      |
|               | 2                    | From tongue.                       | One cyst; one malignant growth.                                                                                                                                                                                  |                                                                                                                                                      |
|               | 2                    | From tonsils.                      | For hypertrophy.                                                                                                                                                                                                 |                                                                                                                                                      |
| 19            | 1                    | Ligation of brachial at two points | For ruptured traumatic aneurism, old operation.                                                                                                                                                                  | Some sloughing from pressure previous to operation. Slow healing afterward with aseptic suppuration. Case ran an afebrile course to entire recovery. |
| 20            |                      | Sequestrotomy.                     | In these cases the cyanide gauze was used freely as packing and was found to work excellently well. As the bone cavities slowly granulated, the discharges remained sweet, and were serous rather than purulent. | Recovery in each case.                                                                                                                               |
|               | 2                    | Of femur.                          |                                                                                                                                                                                                                  |                                                                                                                                                      |
|               | 2                    | Of tibia.                          |                                                                                                                                                                                                                  |                                                                                                                                                      |
|               | 1                    | Of cranium.                        |                                                                                                                                                                                                                  |                                                                                                                                                      |
|               |                      | Ununited fracture                  | Both of these cases were operated on by wiring. In the former the implantation of sterilized bone was tried, but was not successful.                                                                             |                                                                                                                                                      |
| 21            |                      | Of humerus.                        |                                                                                                                                                                                                                  | One failure. One recovery. No suppuration or fever in either case.                                                                                   |
|               |                      | Of tibia.                          |                                                                                                                                                                                                                  |                                                                                                                                                      |
|               |                      | Abscess.                           | In all of these antiseptic irrigation with bichloride was used, and recently with peroxide of hydrogen, always followed by packing with either cyanide or iodoform gauze.                                        |                                                                                                                                                      |
|               |                      | 6 Acute.                           |                                                                                                                                                                                                                  |                                                                                                                                                      |
| 22            |                      | 5 Chronic.                         |                                                                                                                                                                                                                  | All recovered. Profuse suppuration ceased almost immediately and the cavities rapidly closed during a moderate serous oozing.                        |
|               |                      | 2 Of bone.                         |                                                                                                                                                                                                                  |                                                                                                                                                      |
|               |                      | Perineal section.                  | In all the retained catheter was used and the wound was treated in accordance with the antiseptic methods described in this paper. Cyanide gauze packing was employed when necessary.                            |                                                                                                                                                      |
|               | 3                    | Rupture of urethra.                |                                                                                                                                                                                                                  |                                                                                                                                                      |

TABLE.—CONTINUED.

| No. of Cases.<br>Group. | Operations.                                                                                                                                                                                                                               | Memoranda.                                                                                                                                 | Results.                                                                                                                                |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 23                      | 2 False passage.<br>1 Traumatic stricture.                                                                                                                                                                                                |                                                                                                                                            |                                                                                                                                         |
| 24                      | Plastic operation.<br><br>1 To make upper lip.<br>2 To make lower lip.<br>1 To remove epithelioma of cheek and lower lid.                                                                                                                 | Union by first intention in all except two, in which tension caused separation of line of flaps. In those union by granulation took place. | Recovery.                                                                                                                               |
| 25                      | Anal and rectal operations.<br><br>8 For fissure.<br>6 For hæmorrhoids.<br>10 For fistula.<br>1 For rectal fibroids.                                                                                                                      | In these cases either the cyanide or the iodoform gauze was used in packing.                                                               | Recovery in every case. Afebrile course. No suppuration.                                                                                |
| 26                      | Compound fractures in which drainage and antiseptic dressings were used.<br><br>3 Skull (included under trephining).<br>1 Humerus.<br>1 Humerus & both bones and forearm.<br>6 Tibia.<br>4 Both bones of leg.<br>3 Tarsus and metatarsus. | In these cases sterilized iodoform was used in addition to the gauze.                                                                      | Recovery in every case. No fever. No suppuration, except in last case when the injury was crushing and the damage to tissues excessive. |



It will be observed that there are but five deaths in this list, two of them due to pre-existent and chronic disease; the other three were abdominal cases, operated on with the patients almost *in extremis*, with swollen bellies, intestinal paresis, and in one case with suppurative peritonitis. The surgeon who has not lost such as these in spite of his best efforts and most careful application of antiseptic and operative methods has, indeed, been fortunate.

I can truthfully say that in the whole list there have not been six freely suppurating cases, and that there have been no cases of septic trouble and no deaths from any form of blood-poisoning.

The majority of these cases have been observed from beginning to end by sections of the University class, and have been under the daily care of my residents at the University Hospital. Of most of them I have elaborate clinical reports, made by members of the third year classes, and handed in to my assistants at the completion of the case.

Upon others I have operated in private for well known physicians. I am sure that all who have seen these cases, whether students or practitioners, will corroborate my statements both as to the harmlessness and the efficacy of the method in question.

I am glad to be able to give this positive testimony in favor of the latest Listerian method, which, while it may not be permanent (as there are yet many opportunities for improvement before the *ideal* dressing is reached), is obviously undeserving the epithets of "deadly and dangerous," applied to it by Mr. Tait, without, I will venture to say, his having taken the trouble to watch its effect in a single instance, to calculate the quantity of cyanide in a single dressing, to consider the improbability of absorption, or indeed to give the matter any serious consideration whatever. For an example of the unscientific spirit which Mr. Tait justly claims for himself, and for absence of the humility which he unjustly pretends to associate with it, as well as for absolute recklessness of statement, commend me to the paragraph I have quoted about the cyanide dressing.

I must not be understood in my eulogies of antisepsis as

meaning to depreciate efforts made to attain the surgeon's ideal condition of operative wounds, *i. e.*, perfect asepsis. There is no opposition between them. On the contrary, asepsis is the outcome of antisepsis, but I must confess to grave doubts of the efficacy of many of the means advocated to this end, and of some of the testimony in relation to it. These doubts are founded on a comparison between published results and observed cases in the hands of some eminent European surgeons—the almost uniform effect upon my mind of such opportunities of comparison having been a distinct loss of confidence in the statistical reports. I saw, for example, a series of cases of excision of the breast, with pigmented irritable scars, with suppuration, with dressings that were perceptibly stinking, shown to a distinguished surgical audience, the operator and lecturer being a vigorous advocate of asepsis as opposed to antisepsis, and having in his clinic elaborate apparatus for the sterilization of dressings by steam heat under pressure, admittedly the best of all the non-chemical sterilizing methods yet discovered. These cases were in such marked contrast to what I had read of the results obtained at this clinic that the experience was a great shock to my faith in current surgical literature, a shock from which it has scarcely yet recovered.

It cannot be disputed that in the light of modern science the operator has a two-fold duty, *viz.*, to prevent the entrance of living pathogenic microbes into the wound and at the same time to preserve the vitality of the tissues themselves. We have already spoken of the phagocytic theory of Metchnikoff<sup>9</sup>, and in addition we have learned through Waterhouse's experiments<sup>10</sup> and through the clinical experience already spoken of, of the anti-bacteric power of the peritoneum. Bouchard and others have observed the destruction of bacilli by the spleen and their elimination by the kidneys, as in typhoid fever. Buchner and Lubarsch<sup>11</sup> have shown the bactericidal power of blood-serum or of some substance such as the fibrin ferment

<sup>9</sup>Fortschritte der Medizin, Bd. 2, 1884, No. 17

<sup>10</sup>Virchow's Arch., Bd. 119, heft 3, p. 342.

<sup>11</sup>Versammlung Deutsch Naturforsch und Aerzte, Heidelberg, 1889.

contained therein. We have abundant reason, therefore, to believe in a general antagonism between the body cells and the micro-organisms of disease, even if, with our friend, Dr. William Osler<sup>12</sup>, we are compelled to consider the question of phagocytosis as still an open one. It follows that the theoretical propriety of non-interference with these tissues cannot be doubted, and Lister plainly admitted and accepted this new view when he said that the floating particles of the air having been shown to be less harmful than was supposed, we may possibly dispense with antiseptic washing and irrigation, "provided always that we can trust ourselves and our assistants to avoid the introduction into the wound of septic defilement from other than atmospheric sources."

When this method is adopted it is evident that all strong antiseptic solutions which might compromise the vitality of the tissues must be discarded; instruments, silk, ligatures, sponges, etc., must be sterilized by heat, hands must be washed clean in sterilized water (after previous chemical disinfection), and the same is true of the skin over the field of operation. If antiseptic solutions are used at all, they must be very feeble—1:60 carbolic for instruments (after previous sterilization by heat), 1:10,000 sublimate for sponges, etc.

In the meantime, however, while waiting for further improvement in this direction I have felt and still feel that it is safer in a large general clinic, with several assistants and with numbers of students actively participating in the operative work, to depend upon full antisepsis rather than upon asepsis, and I have in the cases above cited and in large numbers of others, not of enough importance to include in the table, employed the following methods, substantially based on those of Lister himself, as described to me in a private letter of last January. They represent, therefore, the latest views made public before the Berlin address.

I need not detain you with a description of the preparation of the gauze itself. This can be found in detail in *The Lancet* for November 9, 1889, and January 4, 1890.

Immediately over the wound is placed a portion of the cya-

<sup>12</sup>Medical News, April 13 and 20, 1889.



nide gauze, washed in a solution of carbolic acid to get rid of the bichloride of mercury in the dressing in contact with the wound. For this purpose one part of carbolic acid to twenty of water is safer than any weaker solution. A very pure acid should be used, because, if impure, it is not completely dissolved, and the undissolved particles are needlessly irritating to the surgeon's hands. When a dressing is changed this piece of gauze is applied over the wound before the surrounding parts are cleaned with the carbolic solution. The carbolic acid soon flies off from the washed gauze, leaving nothing in it in contact with the wound but the unirritating cyanide.

By proceeding in this way it is not necessary to use "protective." The amount of unwashed gauze to be applied will depend upon the amount of discharge anticipated. In the early stage of a wound, where we expect much sero-sanguineous oozing, it is desirable to use a considerable mass, say an inch in thickness, and extending on all sides beyond the wound. Further, it is well, where free discharge may occur, to place over the dressing a piece of thin mackintosh with the caoutchouc side (antiseptically washed) next the dressing. This is for the purpose of preventing the discharge from coming directly through the dressing. It should not, of course, overlap the gauze, nor need it even extend to its edge. When the part operated on is placed on a splint, as after resection of the knee, the padding of the splint is lined with such a piece of mackintosh.

It is unnecessary to purify bandages or elastic bands that are placed outside of dressings, but if a bandage is used in the interior of a dressing, as in bandaging a stump next the skin, it is purified sufficiently by soaking it thoroughly with a solution of corrosive sublimate 1:2000. For purifying the skin 1:20 carbolic acid in 1:500 sublimate solution is used. The towels placed around the seat of operation are wrung out of 1:2000 sublimate lotion, and this is also used for the sponges during the operations. The carbolic solution is also used for purifying the instruments before an operation. At the end of an operation, before beginning to stitch, the wound may be washed with 1:500 sublimate lotion, and irrigated with 1:4000 during the stitching.

But where a joint, such as the knee, is opened the use of the strong sublimate solution, which is seriously irritating to the synovial membrane should be avoided; and in that case it is better to irrigate through the whole operation with 1:4000. As to rendering wounds aseptic which have been infected, that is, speaking generally, a thing on which we can never reckon with absolute certainty; in recent wounds, like compound fractures, the chance of success is, of course, always greater the shorter the time that has elapsed after the infliction of the injury.

If the skin and wound are greasy, oil of turpentine is of great value for cleaning away the dirt, and the use of a nailbrush with carbolic and sublimate solutions, after the turpentine (or without it if there be no special occasion for its use), is very valuable. In many cases where septic sinuses are present, it is hopeless to try to extirpate the septic mischief; but very great advantage is gained by washing the cut surfaces in an operation under such circumstances with a solution of chloride of zinc, forty grains to the ounce of water. This is done once for all at the conclusion of the operation, and prevents putrefaction during the critical early days. The same solution is used where the wound communicates with a septic cavity, as after the removal of a portion of a tongue, or of a jaw; and under these circumstances it is also useful to apply iodoform to the cut surface after the chloride. In cases in which the septicallly infected part is of very limited extent, as, for example, where a suppurating strumous gland has discharged without an antiseptic dressing, complete disinfection may often be obtained by applying undiluted liquid carbolic acid, after scraping away the degenerated glandular or other tissue with a sharp spoon.

I have recently learned to value peroxide of hydrogen very highly as an antiseptic especially in suppurating cases and am using it more largely than ever before.

This address has already assumed an inordinate length on account of the necessity for free quotation, but I cannot conclude it without a protest against the tone of Mr. Tait's paper and against the personal virulence of its references to Lister. There is, unquestionably, room for legitimate differences of

opinion as to the treatment of operative wounds; there are many problems relating to the principles involved which are yet unsolved; the precise comparative value of the different factors, which taken together, have given modern surgery its scientific exactness, is yet to be determined; argument and discussion are not only excusable but highly desirable and, conducted in a proper spirit, could scarcely fail to be productive of great benefit to surgery and humanity. But this is not to be brought about by invective or by personal detraction. Mr. Tait discloses his real animus when he complains that for twelve years he has been "ignored" by Lister, and his controversial writings show that he probably belongs to that class of persons who feel far more deeply injured by neglect than by assault.

It is doubtless true that he and his work, carried on in a special line and under special conditions, have not in the consideration of the whole subject been elevated into the prominence which he thinks they deserve; but how many of us in this world are taken at our own valuation, either personally or professionally?

Lister's work since he took his first degree in 1852 has been of a character to command the respect and admiration of the scientific world. Receiving the first prizes in botany and anatomy when he passed the M. B. examination, he won the gold medal and the scholarship in surgery in the final examination. His papers on the minute anatomy of the skin, the physiology of the lacteal current, the contractility of the iris, the microscopic anatomy of involuntary muscular fibre, the relations of the inhibitory system to the visceral nerves, the regulation of arterial contraction by the nervous system, the early stages of inflammation, the coagulation of the blood, etc., stamped him at once as an original investigator of the first rank, and as one of his biographers says "would have sufficed to make his career memorable if he had never applied antiseptic measures to the treatment of disease." I have heard Prof. Louis Agassiz years ago and later Prof. Joseph Leidy say that, viewed from the standpoint of abstract science, his work had been of the very highest order and the appreciation of his labors by the best minds in our own profession



has been enthusiastic and almost universal. Nearly every great surgeon in the civilized world has put on record his admiration for Lister's teachings, his acceptance of the general principles involved and his sense of almost personal obligation to the author of the antiseptic theory.

That Mr. Tait should speak of such a man as having "lived in the clouds of his spray for the last twelve years," as "wanting in logic," having "crude notions of logical definition," making "illogical blunders," "falling away from his own faith," promulgating an "absolute and ludicrous logical error," etc., and should make a boast of having "laughed at" and "ridiculed" him and his doctrines and disciples, is, it seems to me, evidence of his unfitness by temperament or training (or from lack of the latter) for the serious discussion of broad surgical principles. I am quite sure that the vast majority of general surgeons will be found to have no sympathy with either his views or his manner of expressing them, and it is a relief to find that in his own special line there are operators of equal eminence who repudiate both. In an address on "Abdominal Surgery, Past and Present" recently delivered before the Medical Society of London, its President, Mr. J. Knowsley Thornton, said: "I am not ashamed still to use the spray and all the precautions which have advanced my results in ovariectomy to 1.88% mortality (as against Bantock's 4 and Tait's 3.3%) and I find increased practice and a steady adherence to methods which have yielded me good results in the past increase in like ratio my success in all abdominal operations. Every operator of prominence improved his results enormously as soon as he adopted Listerism; then having learnt how to be surgically clean, he has found for himself ways of attaining this end with more or less success by methods differing from those of Lister. The sum and substance of it all is, that if we had never had Lister to teach us true cleanliness, we should never have used antiseptics, flushings or drainage tubes to attain it. The great advance is due to the antiseptic system, the minor details are merely the different ways of attaining the same end—asepticity. Time alone will show what is worth retaining and what we may safely cast aside."









